A HANDY PHOTOMICROGRAPHIC CAMERA.

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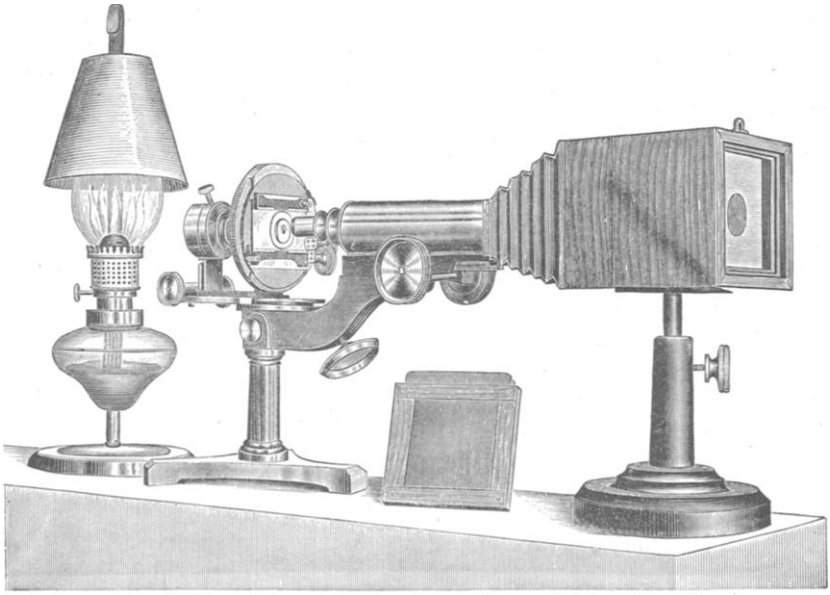
The growing usefulness and popularity of photomicrography, by which the published work of the observer is fully and accurately illustrated, makes it desirable to have a small, simple camera that can at once be readily applied to the microscope without alteration, save bringing the body to a horizontal position. That simple means will do good work is proved by a print I have of *Pleurosigma angulatum*, X 2,400, by Spencer's 1–10 homogeneous objective, illuminated by a single-wick coal-oil lamp. It was made by Dr. J. E. Baker, of Wyoming, Ohio, and is fully equal to the best work of Zeiss apochromatics with all their appliances.



The "Handy" camera as applied to the microscope.

My friend, Mr. H. Wingate, of Philadelphia, has long been an ardent worker with the microscope, his studies being almost exclusively confined to the minute fungi belonging to the family of myxogastres. He is exceedingly skillful with the pencil, and his drawings of these minute organisms, their spores, etc., are at least equal to any that have ever come under my observation ; but, being actively engaged in business, the time wasted in making these drawings was a large tax, and he determined upon calling in the aid of photography ; and, there being absolutely no camera in the market to meet his requirements, he proceeded to construct one. Procuring a plate-holder of the proper size, he built the camera to suit it, after the plan of the man who carried the bunghole to a cooper shop to have a barrel made for it. His materials were some heavy, blackened card-board and an old piece of a steam-fitting some four inches long ; his tools a pocket-knife and a glue pot, with the brains to use them. With these crude appliances he produced a camera adapted to his microscope and capable of doing the highest class of work. He uses a Zeiss 1–18th homogeneous lens constantly, and frequently makes a dozen or more negatives of an evening therewith.

Upon seeing this little affair I was at once struck with the conviction that if it could be produced in a form adaptable to any microscope it would fully meet the long-felt want of just such an instrument.. The result was the construction of the "Handy" camera, which has already been supplied to many institutions of learning and to private workers.

The camera consists of a mahogany box about 2⅝″ square, corrugated and blackened on the inside to prevent any reflections of light. A solid cone of some four inches in length, tapering to receive the tube of the microscope, is attached to the front of the box. Preferably this cone front should be in bellows form, as in the sample sent ; but, being rather more costly than the solid cone, many will be satisfied with the latter. In the one case the bellows respond readily to the movements of the microscope tube in focusing ; in the other the tube must slide readily into and out of the solid cone. At the opposite end of the box is a groove, in which the plate-holder and frame containing the focusing screen slide. The former carries two plates, 2½″ square, amply large for all ordinary illustrations. Should larger-sized pictures be required they can be made by enlarging upon bromide paper. The focusing screen is made of very thin crystal glass, most carefully ground by hand, presenting the smoothest surface obtainable by this means, but still quite too coarse for the

exact focusing of delicately marked objects. In fact, the focusing screen is mainly useful in procuring even and full illuminations of the field, and in properly centering the object. The final fixing of the exact focus is done by means of a focusing glass used in conjunction with a disk of thin cover glass attached to the ground surface of the screen by means of Canada balsam.

The camera is mounted upon a stout metal rod, which slides into the upright shaft of a very heavy japanned base, and can be secured at any height to suit that of the microscope (when the latter is inclined to a horizontal position) by means of a milled head. The base is shod with thick felt cloth, so that it may be placed upon any polished table-top without scratching the latter, and at the same time remain firmly fixed in the position it may be placed in.

And this is all there is of it—simple, compact, always ready for immediate service, and occupying no appreciable space upon the work-table. Although primarily intended for use with the microscope body inclined to a horizontal position, it may be as readily adapted to the latter in a vertical one, when the character of the object (as those mounted in fluids) may require. My own method has been to remove the camera from its base and mount it upon the top of an open box containing the microscope. An opening in the top of the box allows the cone to be slipped over the tube of the microscope, and in this manner I have made very successful negatives of blood corpuscles in rouleaux in their own serum, yeast spores in fluid, &c. A correspondent in Boston writes me that he has mounted the camera upon a firm retort stand for the same purpose. Many methods of using the instrument in an upright position will doubtless present themselves to the worker therewith.

The illumination may be effected by reflections from the mirror, as in ordinary work, or by removing the latter and placing the lamp behind the stage and in a direct line with the optic axis. It must be carefully centered in order to illuminate the field alike in all portions. Condensers of various kinds, bull's-eye, achromatic, Abbé, &c., can be used as desired; but with moderate and low powers the best results will be obtained by the employment of simple diaphragms of various sizes to suit, and so placed as to come close as possible to the under surface of the slide upon which the object is mounted. All extraneous light should be excluded, so far as possible, and none be allowed to enter the objective other than the rays which illuminate the specimen. Opaque objects may be photographed quite as successfully as transparent ones, but the time of exposure

will be very greatly shortened by employing direct sunlight as the illuminant, if possible.

The eye-piece may be removed or not, as the observer may elect. Following after the teachings and practice of the late Dr. J. J. Woodward, I have almost invariably worked without it, using an amplifier where sufficient magnification could not be obtained with the objective alone. In using medium and high powers I have not found the eye-piece objectionable, but with low powers it certainly detracts from sharpness of definition; so that my preference is decidedly in favor of the amplifier where an increase of power beyond that obtainable with the unaided objective becomes necessary. If possible, however, always use the latter alone. The short-tube length, alone possible (when using the "Handy" camera), renders the employment of amplifier or ocular necessary, if enlargements beyond three or four hundred diameters are to be made, since the limit of a 1–18th used direct is less than X 350.

The corrections of most modern objectives, as to visual and actinic foci, are so nearly identical that no difficulty will be experienced in obtaining sharp definition of any subject if a little care be used; but it may not be amiss to say the students' series of Bausch & Lomb are the best by all odds of any I have ever seen or used at all approaching them in moderation of cost. I have numerous remarkable examples of their work which I have never seen excelled by lenses of equal powers, no matter what their cost. It certainly is not necessary to go abroad in these latter days to get the best in the optical as well as in many other directions.

The dry plates for the "Handy" camera are furnished by the makers in two degrees of sensitiveness, to suit every variety of subject. They are readily developed by any of the methods used for gelatine plates, my own preference being given to hydrochinon, or a mixture of that with eikonogen, as giving the clearest results, clearest details, and sharpest contrasts with any desired amount of density. Their cost is but twenty-five cents per dozen—certainly cheap enough to tempt any one to their use.

It may not be amiss, in conclusion, to say a few words upon various printing methods. Presuming that every microscopist who ventures into the realms of photography will do his own printing, perhaps a few hints culled from the fields of experience may prove useful. There can be no doubt of the beauty and perfection of a good, properly toned, and finished print upon albumenized paper. This is conceded; but comparatively few amatures will ever succeed

perfectly in the operations of sensitizing the paper and toning the print, while most of the "ready-sensitized" paper on the market is an abomination and a snare. Therefore discard this method of printing unless prepared to do first-class work.

Passing by platinum, as being both expensive and uncertain, excepting in the hands of an expert (although its beauty and perfection cannot be too highly extolled), let us consider for a moment the decided claim of bromide paper as being the best material for printing in our class of work. Using the smooth-surface paper and developing with ferrous oxalate, we get a perfect print, rendering the most delicate details with the crispness and clearness of a steel-plate engraving, which, indeed, it most closely resembles in very many instances. The exposure is made by lamplight, so that one is entirely independent of time or weather, and the finished print is absolutely permanent, as much so, it is reasonable to believe, as a carbon print. If the sheet be allowed to dry spontaneously it will present the appearance of an ordinary plate engraving. If a polished surface be desired, all that is necessary will be to float the paper, print side down, upon a sheet of polished hard rubber, to squeeze it into optical contact, removing all superfluous moisture, and when quite dry it will peel off the rubber plate with a beautiful polished surface, greatly increasing the delicacy of detail in many subjects, especially diatoms. Most decidedly my preference in given to this form of printing.

But there is another method which, at the risk of being laughed at, I am inclined to gently urge upon my brethern of the tube. I refer to the ferro-prussiate, or more commonly named "blue prints." This method of printing is tabooed in many instances, "blue prints" being vigorously proscribed in the albums of The Postal Photographic Club; but for all that it has decided advantages and merits for the work we are considering. It is cheap, as the paper may be purchased ready sensitized at a very trifling cost, and it requires no skill or experience in the using. It is merely necessary to expose to bright sunlight until sufficiently printed (a few experiments will determine this), and then to wash in several changes of water, the result being a bright, permanent blue print upon a clear white ground, with excellent detail, excepting in the most delicate structures.

The negatives made with the "Handy" camera are of a convenient size for printing lantern slides by contact. A print on glass is certainly the most perfect of any that possibly can be made, and

the importance of this method of demonstration has long since been conceded. Gelatine plates, coated on thin glass with special slow emulsions, are furnished by several makers, and any microscopist can readily make his own lantern slides with a little expenditure of time and patience. I submit with this paper specimens of printing in all their various methods for "Handy" camera negatives; also a reproduction by one of the many block processes now in use for book illustration. True, photogravure is the best process for such work, but in many cases the cheaper one herewith shown answers an excellent purpose. One of the cameras is also sent for the inspection of members interested in the subject, as I trust the majority of them will be.